

Name _____

Period _____ Date _____

Glacier Simulation Activity

Objectives:

- Determine the factors that affect the motion of glaciers, and calculate the speed of glacier movement.
- Discover what a glacier budget means for the growth and destruction of a glacier, and describe the features it leaves behind.

Predictions

1. If the average annual snowfall increases (m/yr), what will happen to the glacier?
2. If the temperature changed, describe the two things that could change in the glacier?
3. If the temperature is decreased and the snowfall is increased, will the equilibrium line move up the mountain or down the mountain? Explain.
 - What will this do to the glacier? (advance or retreat) Explain.
 - What will happen to the glaciers thickness and length? Explain.

Background

Equilibrium line: This line indicates the boundary where the freezing meets the melting of the glacier. Change some factors and describe what happens to the equilibrium line and what happens to the glacier.

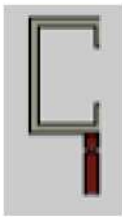
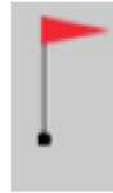
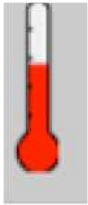
4. Describe the following terms to someone who did not study Earth Science.
 - a. Glacier –
 - b. Iceberg –
5. Glaciers are described as the “Most Erosive Force in Nature”, what does this statement mean? Explain the difference between weathering and erosion.

Procedure

Google “Phet + simulation + glacier” and click on the first link, then “RUN”

Open <http://phet.colorado.edu/new/simulations/> and click on “Glacier”, or go to

- Turn off the snowfall effect & play with simulation for 5 minutes. Grab the bear and change viewpoints, try to make the glacier grow/shrink. If the glacier disappears hit the “Reset All” button.
- Look at the toolbox to identify each tool and describe what it can be used to measure.



6. When you set the temperature and snowfall; and hit the STEADY STATE button, what happens to the glacier?

Part I. Glacier Speed: Using the toolbox you will determine the speed of a glacier, and what parts of a glacier move faster than others.

Drilling: Set to the temperature and snowfall to an amount that creates a decent sized glacier. Press the “STEADY STATE” button and Pause the motion of the glacier. Drill several vertical holes through the glacier.

7. Draw a sketch of what the glacier looks like with the drill holes, before the glacier moves again.

Before movement

After movement

8. Explain why your drawing appears this way. What is the cause of this phenomenon?

9. To determine the speed of the glacier, two quantities are needed: distance and time. Pause the glacier to allow accurate measurements.
- Measurement: Place the flag on the glacier at a known distance (Use the GPS or coordinate system to assist you). Record the initial horizontal position of the flag and the initial time in the table below:

	Position (meters)			Time (Years)
Initial distance			Initial time:	
Final distance			Final time:	
Final – Initial =				

- Show your work! $\text{Speed} = (\text{change in position}) / (\text{change in time})$

II. Glacier Observations

Many features are present when a glacier advances or retreats on a mountain slope.

Answer the following questions about the features of the glacier valley.

1. What are the tiny black dots that move through the glacier? Where did this material originate? Where are the black dots deposited?
2. Make the glacier retreat up the mountain. What happens to all the material that is moved with the glacier? Why is the stream curvy?
3. In the background, why are the mountains spiked?
4. Create the largest glacier possible and turn the time up to FAST.
 - a. What is created at the end of the glacier time goes on?
5. Press RESET ALL, and set the glacier back to its starting location. Make the glacier completely melt away. Once this is done, increase the snowfall to maximum and decrease the temperature to its lowest point.
 - a. How many years will it take the glacier to return to its original position?
 - b. Could this occur in real life?

III. Glacier Budget

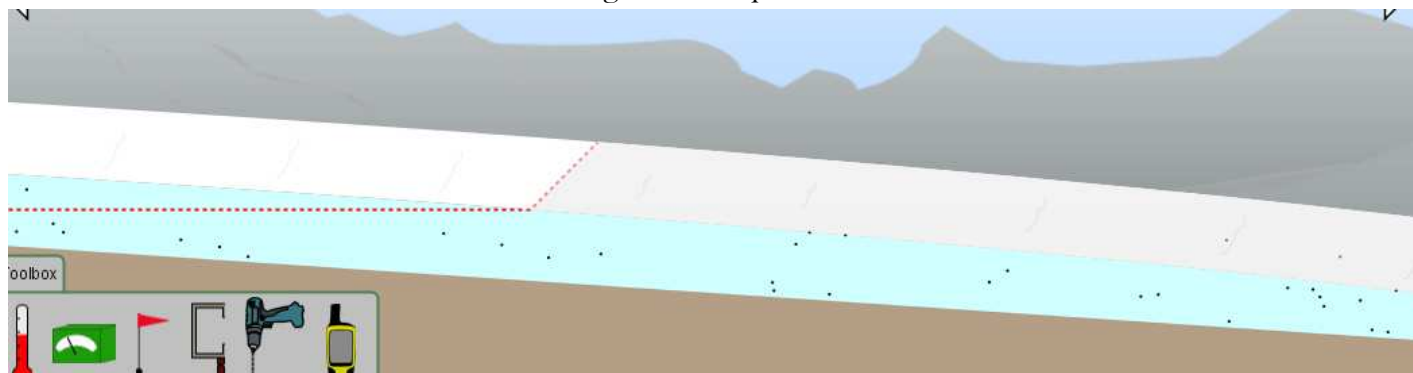
In this section you will observe how a glacier budget is determined and its meaning for the state of the glacier. Define the following terms:

- a. Accumulation –
- b. Ablation –
- c. Glacier Budget – the rate of how much a glacier will grow or retreat each year.

$$\text{Glacier Budget} = \text{Accumulation} - \text{Ablation}$$

Create a glacier your own unique glacier.

1. Using the green box (budget-meter), place the meter on the glacier in 3 locations: A, B, and C. Record the accumulation, ablation, and budget at each point



- A: _____
 - B: _____
 - C: _____
2. What is the glacial budget equal to at point B? What does this have to do with the equilibrium line?
 3. Using the depth meter, determine the thickest/deepest section of your glacier. Why do you think this section of the glacier is the thickest/deepest?

Conclusion:

1. What is the relationship between the following:
 - a. Temperature and glacier size _____
 - b. Snowfall amount and glacier size. _____
2. Explain what causes a glacier to grow or recede?